A Boost for Wireless Monitoring

BSTeR creates webs of distributed battery-powered sensors that can monitor temperature, vibration, or nearby movement

The Internet and cell phones have revolutionized telecommunications. The next revolution could be in wireless sensor networks, which are webs of distributed battery-powered sensors that monitor such things as temperature, vibration, or nearby movement—movement on a battlefield or border, for example.

In Los Alamos, computer scientist Sami Ayyorgun helps these networks reach their potential with his new operational scheme: BSTeR (pronounced "booster"), for Boost by Smart Transmit-power Random-variables. The BSTeR scheme adjusts the sensors' transmission powers intelligently, while dynamically adapting to changes in the network's condition (sensor locations, for example), resulting in a "self-organizing" network.

Unlike cell phones, which use an array of towers to pass messages between phones, wireless sensor networks deal directly with their fellows. One sensor "hops" a message to another, which relays it forward until, sensor by sensor (multihopping), the information reaches its destination.

In a standard, fixed-power scheme, each sensor always transmits each hop at the same power level, over the same distance, and through the same forwarding sensors. Since the same sensors are always being activated, their batteries run down more quickly. "Energy efficiency is a first-class design criterion," says Ayyorgun, so he has designed the BSTeR scheme to not always send messages down the same path. With BSTeR, each sensor chooses one of many possible power levels for each hop it transmits, basing that choice on a random number generated by an internal processor. A higher power level turns a hop into a leap, sending a message to a more-distant sensor, which then generates its own randomly powered hop.

The diversity of transmission powers for each sensor exponentially yields many different pathways, activating different sensors and spreading power usage across the network. Over many messages, the improvements on speed and other performance metrics add up significantly, resulting in concurrent performance gains over many metrics—the first such concurrent gains reported in the literataure.

Ayyorgun presented the BSTeR scheme in the Plenary Session of the Institute of Electrical and Electronics Engineers' (IEEE) International Conference on Mobile Ad Hoc and Sensor Systems (a premier publication venue of the IEEE) in Atlanta on September 30.